“Android App Suite Chemical Engineering”

By

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Dissertation submitted in partial fulfilment of
the requirements for the
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CERTIFICATION OF APPROVAL

Android App Suite Chemical Engineering

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A project dissertation submitted to the
Information & Communication Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
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Approved by,

____

(DR. YONG SUET PENG)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
May 2014

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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HEYRMATHA RATNAM

ABSTRACT

"Android App Suite Chemical Engineering" is a mobile application for chemical engineering students in Universiti Teknologi Petronas(UTP) to learn more about chemical Process Dynamic and Control subject at anytime and anywhere. This project would solve the problem that Chemical Engineering students in UTP face in learning Process Dynamic and Control, and them understand about Chemical Process Dynamic and Control (CPDC) subject. This report will focus on the introduction of the project, followed by the literature review, the methodology used which is Rapid Application Development Process (RAD), results and discussion of the project and lastly conclusion and recommendation resulting from this project. Moreover, the proposed design of the mobile app has also been attached. Techniques that have been used in this project were study and making comparison with available application in the market, study about the flow of the application and research on how to develop the application. This project are been tested against the current method of learning. The design was further enhanced as it is necessary to meet the objectives of this project.

ACKNOWLEDGEMENTS

This research paper is made possible through the help and support from everyone, including: parents, lecturers, friends and people who are involved directly or indirectly in this project. Here, I would like to dedicate my acknowledgement of gratitude toward the following significant advisors and contributors.

Firstly, I would like to thank Dr. Vivian Yong Suet Peng and Dr. Noor Yusmiza for their most support and encouragement as my supervisor and co-supervisor. They kindly offered their help throughout the processes involved in this project. I would also like to thank them for their advices and opinions about my project in order to produce the best end product. They gave me an exposure in few exhibitions that helped me to shape my project in a better way. I also would like to thank Mr. Abdel Raheem, who is a PHD student in UTP who helped me a lot on Process Dynamic and Control formula's for this project.

I sincerely thank to my parents for their moral support and encouragement for me to produce the end product and to complete this project. The product of this project would not be possible without all of them.

Lastly, I would like convey my sincere thanks to my fellow friends that directly and indirectly assisted me to complete my project. They gave me creative ideas in producing a good report as well as end product. Without their help, I will not be able to achieve this much in my project.

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CHAPTER 1
INTRODUCTION

1.1 Background of study

In this modern era, the Smartphones and PDSs become an important role in our daily life. It is very common that people are using the smartphones to deal with their business, booking online, shopping online and also registering themselves through mobile. By making use of the smartphone or mobile applications as an advantage for this project because the Mobile Application is considered as another alternative way to learn Chemical Process Dynamic and Control (CPDC) by chemical engineering student's in universities especially Universiti Teknologi Petnonas. With this I would like to introduce my project which is "Android App Suite Chemical Engineering" which is designed for CPDC subject. So this is the reason why Android App Suite Chemical Engineering are choosed as the Final Year Project. This report is about the overall of Planning, Analysis and Design for my proposed project.

CPDC subject which known also as an engineering discipline has become important in the process industries that deals with architectures, mechanisms and algorithms for maintaining the output of a specific process within a desired range. In working industries, Process control is extensively used and enables mass production of continuous processes such as oil refining, chemicals, power plants and many other industries. So, this subject become one of the important or a must for chemical engineering student be master in order to be able to design and operate modern plants in future.

Using a mobile application, students can easily learn the chemical process control at anytime and anywhere. The reason I choose Android App Suite Chemical Engineering is because I want to create an Android based application which can access through mobile anytime and anywhere. I believe that by develop this app, I can make student from chemical engineering department easy for them to learn on chemical process control. By using some skills and resources that I gained, I want to custom made an mobile based application by using Java programming language. In this system, I implement my knowledge that I learned in class. I hope that this system will help the Chemical Engineering Faculty (CE) students mainly in UTP to learn chemical process control.

1.2 PROBLEM STATEMENT

1.2.1 Lack of automated computerized Process Dynamic Control system

There are the occurrences whereby CE students do not have the suitable mobile application or lack of simulation tools that are needed in order to expertise in Process Control. This is proven during a survey conducted in UTP on lab session that conducted by Dr.Noor Yusmiza who is Chemical Engineering lecturer and also survey lecture session which consists of 25 student that are smart phone expertise. The problem was the lack of Automatic computerized Process control where a group student's need to share a computer in lab session in order to understand.

Figure 1.1 : Current learning scenario at CE lab of UTP

So because of this, it may result or produce poor student quality. Other than that because this problem student will perform poorly when they enter working life where this subject become one of the important or a must for chemical engineering student be master in order to be able to design and operate modern plants in future.

1.2.2 Poor understanding or difficult subject

Based on survey conducted in Universiti Teknologi Petronas shows 90 percentage of student are facing or having difficulties on understanding the Process Dynamic and Control subject. 90 percent which means 18 students out of 20 student facing difficulties on understanding the Process Dynamic and Control subject.

1.3 OBJECTIVES

There are four objectives:

- To investigate the current problem that CE students face in CPDC subject
- To conduct comparative study on existing mobile application that used for/by chemical engineering students.
- To develop Android App Suite Chemical Engineering based on selected methodology to learn Process Dynamic and Control subject.
- To test the mobile application on students against the current way of learning.

1.4 SCOPE OF STUDY

The project will focus on chemical engineering students aged between 19-30 years who are android-based smart phone user and who currently in 3rd year 1st semester and 3rd year 2nd semester . This age is chosen as android-based smart phones and android based application are popular among this age group. Furthermore, this age group who known as generation Y would be considered to be technology savvy. The area of the project would be Universiti Teknologi Petronas to ensure the feasibility of the project. In this project, it will be covered only **one process** in process dynamic and control which are :

- Temperature.

Controller methods :

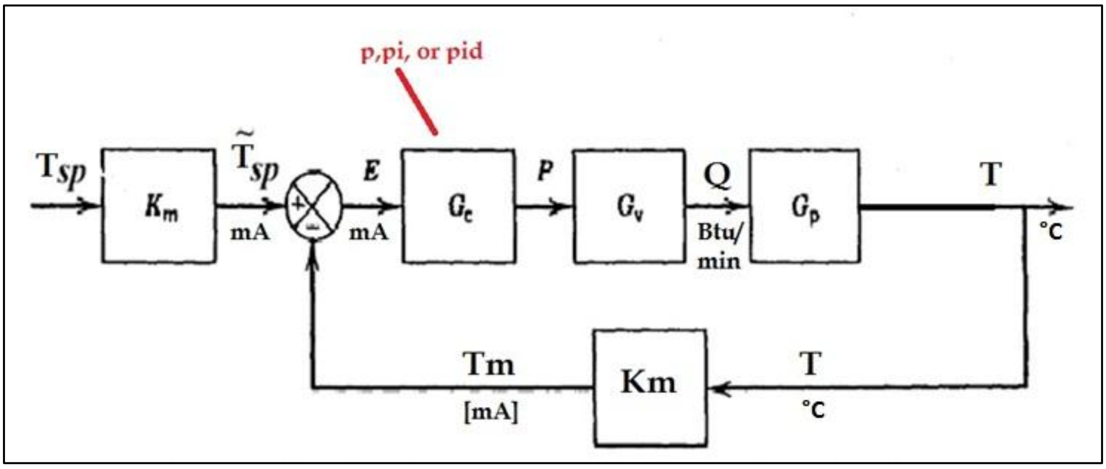

Figure 1.2 : Temperature Process Control Module

Figure 1.2 is an example of temperature process control module that will be used in this system. There are three types control loop mechanism which are widely used in industrial control systems :

- Proportional Controller (P) :

  Often control systems are designed using Proportional Control. In this control method, the control system acts in a way that the control effort is proportional to the error. The control effort is proportional to the error in a proportional control system, and that's what makes it a proportional control system. If it doesn't have that property, it isn't a proportional control systems.

- Proportional Integral Controller (PI) :

  The Proportional-Integral (PI) algorithm computes and transmits a controller output (CO) signal every sample time, T, to the final control element (e.g., valve, variable speed pump). The computed CO from the PI algorithm is influenced by the controller tuning parameters and the controller error, e(t).

PI controllers have two tuning parameters to adjust. While this makes them more challenging to tune than a P-Only controller.

- Proportional-Integral-Derivative Controller (PID) :

  PID controllers are sold in large quantities and are often the solution of choice when a controller is needed to close the loop. The reason PID controllers are so popular is that using PID gives the designer a larger number of options and those options mean that there are more possibilities for changing the dynamics of the system in a way that helps the designer. If the designer works it right s/he can get the advantages of several effects. In particular, starting with a proportional controller, and adding integral and derivative terms to the control the designer can take advantage of the following effects.

Programming language that are used in this project is :

- Java Programming

The **required hardware's** that used in this project includes :

- Tablets
- Mobile Phones

Required Software for this project are :

- Eclipse App Inventor

The main and the most important software used for this project development is Eclipse. Eclipse is one of the most popular Android development platform used by the majority of the Android developers around the world. It is open source software, hence a lot of tutorials and source code available on the internet. That is the main advantage of Android development using Eclipse. With java language, Eclipse able to build Android application and also design the layout or interface of the application using xml format.

- Android Virtual Device (AVD)

AVD is an emulator that stimulates a real Android device such as smart phone and tablet PC. In other words, AVD can be used as a medium to see how the Android application works on real Android devices without having to buy them on the market.

Required techniques that have been used in this project were:

- Study and making comparison with available application in the market that has similarity with Android App Suite Chemical Engineering concept.
- Research on how to develop the application. The common and most popular tool to develop an Android application is Eclipse IDE for Java Developers.
- Study about the flow of the application. It is consists of how to operate and manage the application in a right way.
- Discussion with Supervisor and experts. The discussion is very important because the Supervisor and the experts have higher level of knowledge to help me in this project. Examples of experts are my friends who have been working on Android project during their Internship Program.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Before designing and developing the mobile application, there is a need to understand the fundamentals of android application and components relating to it.

A research has been carry out by GlobalWebIndex (GWI), where in 2013 Android use has climbed from 27% in 2012 to 65% .(Ratcliff,2014). Based on survey conducted in Universiti Teknologi Petronas shows 90 percentage of student are facing or having difficulties on understanding the Process Dynamic and Control subject. 90 percent which means 18 students out of 20 student facing difficulties on understanding the Process Dynamic and Control subject. This literature review is organized to discuss the Chemical Process Dynamic and Control (CPDC), followed by smartphones as learning tools, existing mobile application that are developed for chemical engineering student, and user interface based on Human Computer Interaction for Mobile Application.

2.2 Chemical Process Dynamic and Control (CPDC)

Process dynamic and control which known also as an engineering discipline has become increasing important in the process industries that deals with architectures, mechanisms and algorithms for maintaining the output of a specific process within a desired range. In working industries, CPDC is extensively used and enables mass production of continuous processes such as oil refining, chemicals, power plants and many other industries. So, this subject becomes one of the important or a must for chemical engineering student be master in order to be able to design and operate modern plants in future. This literature review is organized to discuss the smartphone as learning tools, followed by the, and how technology could improve the quality of life through state-of-the-art medical applications.

2.3 Smartphones as Learning Tools

According to electronic resource “eCycle Best” smartphone devices are a revolution as it has become an object or a tool used in our daily life use for communication purposes and to access information. The combination of mobile devices, third generation wireless services with multimedia capabilities, and Internet and portal technology, this allows data and information to be received “anywhere”, “anytime”, and by “anyone” (eCycle Best, 2014). As the ability to retrieve data increase so will the need to retrieve data. This will result in application being built to cater to those needs thus having positive effect on the community as a whole. The paper focused on the impact that Mobile Computing and the opportunity that it opens for application development.

There are study’s that mention the usage of mobile application for education are growing because of the term “anywhere” and “anytime” where student can access to mobile application anytime and anywhere (eCycle Best, 2014). Other than that, student used mobile as the process of obtaining or discovering new information is a form of learning. 1.5 million apps available and 10 percent of it were educational or reference apps (Concordia University, 2014).Below show’s comparison between mobile phone ownership by user and use for academic purpose.

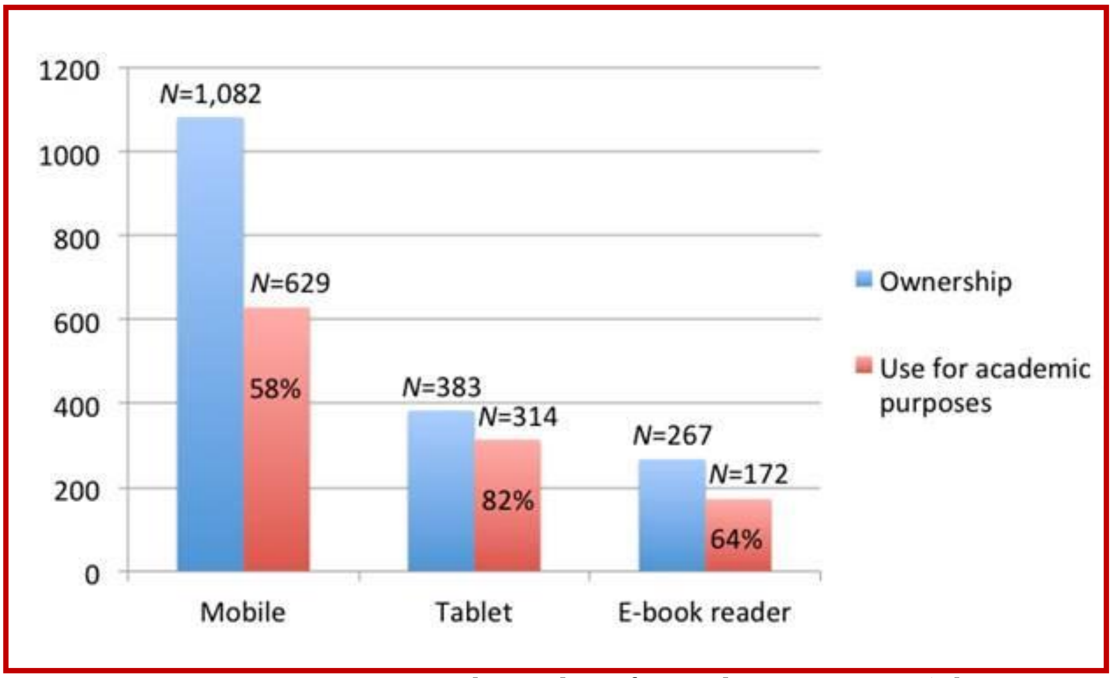

Figure 2.1: Comparing ownership and use for academic purposes (Chen & Denoyelles ,2013)

MacManus (2009) stated that a report has been released by Morgan Stanley entitled, "The Mobile Internet Report" has explained in details about the fast improvement in mobile internet market on these recent years. In the report which was released on December 2009, Morgan Stanley predicted that the Mobile Internet market will be at least double the size of Desktop Internet in 2010. The prediction was made based on analysis comparing Internet users with mobile subscribers. There are more than 500 million iOS and Android smartphones and tablets have been activated since year 2007. It is estimated that by the end of 2012, the iOS and Android devices activation will be increase to 1 billion or more. Statistically, Google Android is now well ahead from Apple"s iOS for iPhone in the stunning race for mobile operating system market share. Below figure 2.1 shows the statistic on Smartphone usage based on the Operating system.

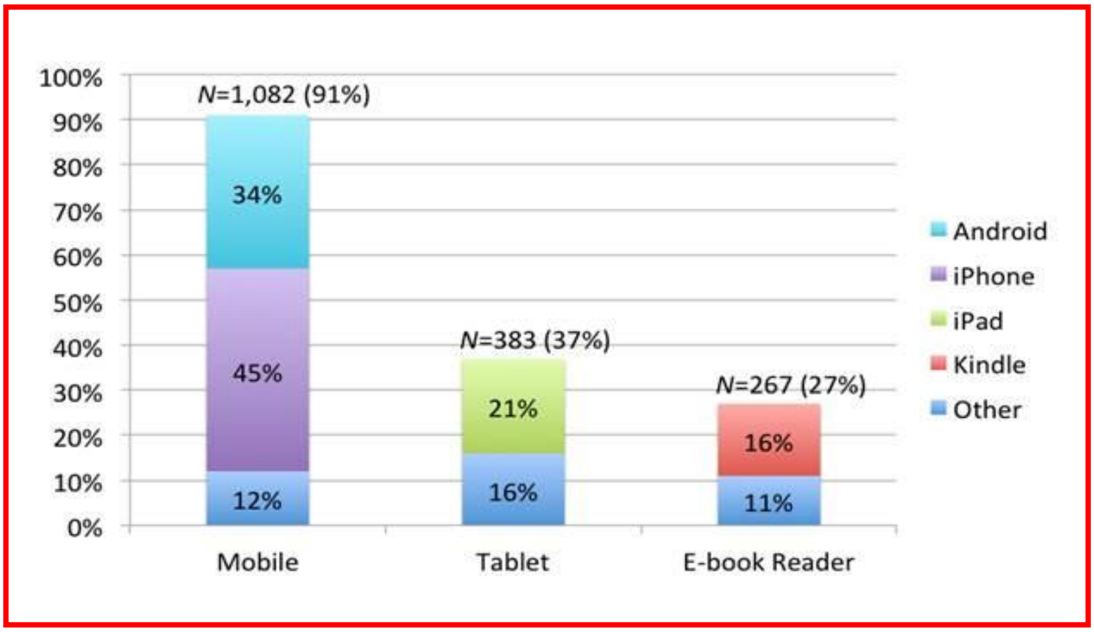

Figure 2.2: Proportion of Smartphone Sales based on operating system (Chen & Denoyelles ,2013)

2.4 Android

Android is a software for mobile devices that has operating system, middleware and key applications. The architecture of the Android is like a stack with Application being the top layer and Linux Kernel being the bottom layer of the Android. (Sharma,2011). Core applications of Android include e-mail client, SMS program, calendar, maps, browsers and contacts which are mostly text input based. An analysis by Ericsson ConsumerLab in Southeast Asia and Oceania, where in Malaysia the usage of Android platform has increased by 16 percentage points to 63% this year from 47% in 2012, while tablet penetration has increased almost three-fold to 39% from 14%.(Khor,2013).

2.5 Existing Mobile App's for Chemical Engineering Student's

There are several mobile app's which are created for chemical engineering student to use. Below are the example's of mobile app's for chemical engineering student :

2.5.1 Chemical Engineer Dictionary

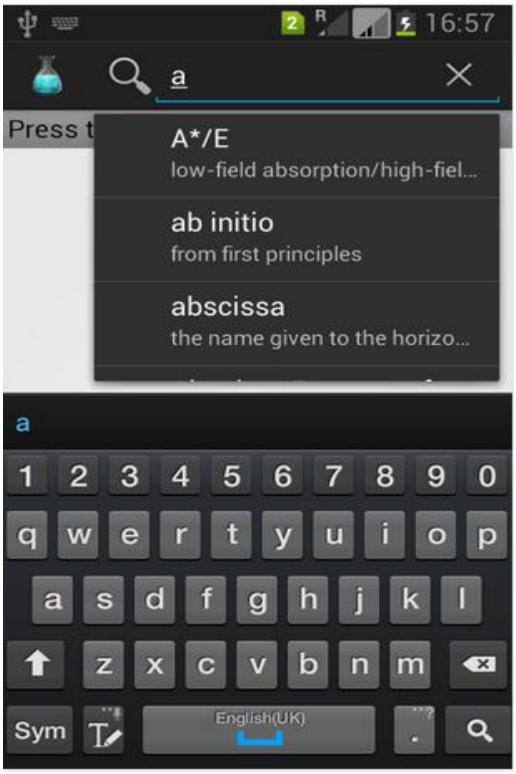

Figure 2.4 : Interface of Chemical Engineer Dictionary app(Ain Dictionary Developers,2013)

Chemical Engineering Dictionary is a mobile app which is used as dictionary chemical engineering studies with mathematics and a branch of engineering that applies the physical sciences such as chemistry , physics and/or life sciences (e.g. biology, microbiology and biochemistry).(Ain Dictionary Developers,2013) Other than that, this app also used economics to processes that convert raw-materials or chemicals into more useful or valuable forms.

2.5.2 Chemistry Assistant

Figure 2.5 : Screen shot of Chemistry Assistance app (Mukker,2013)

Mukker (2013) has invented this Chemistry Assistant which are more to chemical studies and in Chemical Engineering Dictionary App is more to physics, chemistry and life science. Chemistry Assistant is a mobile app that can help student's to view the whole periodic table in a beautifully designed UI .In this app, there are other functions such as Calculate Molar masses, Calculate number of Moles, Calculate Mass Percentages (%), Calculate Values using the Ideal Gas law, Boyle's Law, Charles's Law, Avogadro's Law, Amonton's Law and the images are fetch from Wikipedia.

2.5.3 Graph Lite - function plotter

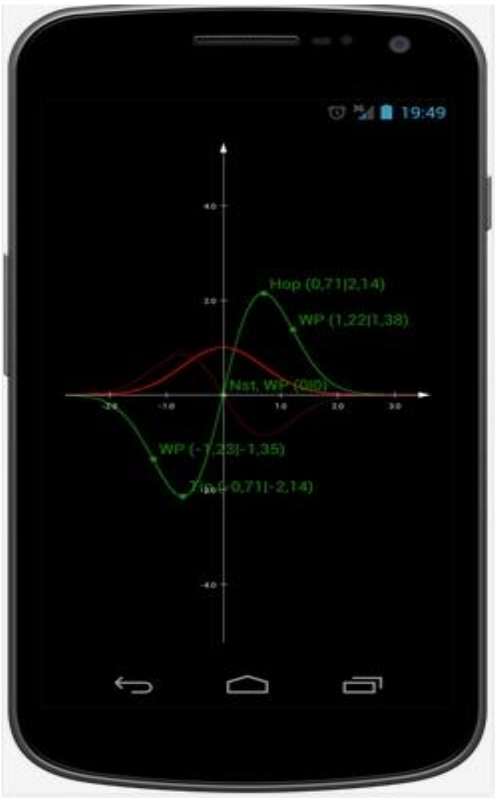

Figure 2.6 : Prototype of Graph Lite - function plotter app (Cassiopeia,2013)

Graph Lite - function plotter is an mobile app that designed by Cassiopeia(2013) to help student to plot graph. This mobile app can give graphic representation of an equation and can support function types such as logarithms, square roots, and more. This mobile app also can possible to define up to 13 parameters and user can explore the graphs (coordinates, tangent, normal). From this app, I can learn how to link equation to the graphical view (Cassiopeia,2013).

2.5.4 Chemical Engineering AppSuite HD

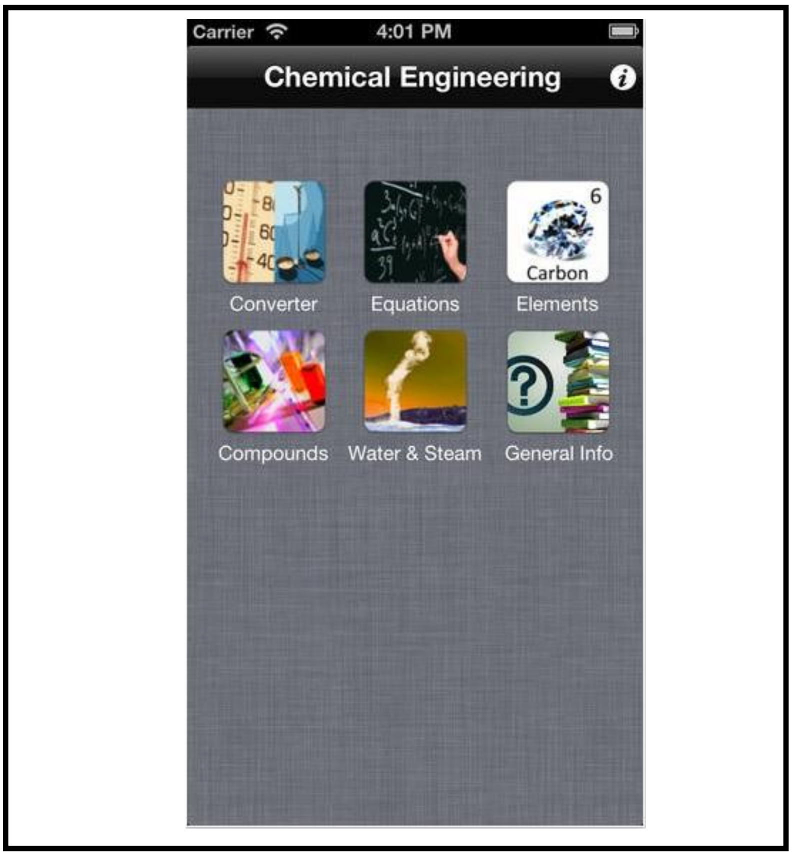

Figure 2.7 : Chemical Engineering AppSuite HD app (Vector,2013)

Chemical Engineering AppSuite HD is an iOS platform application which are help student understanding more than just chemical engineering but also in algebra, electricity, and even in certain areas of physics.

2.5.5 Chem Pro: Chemistry Tutor

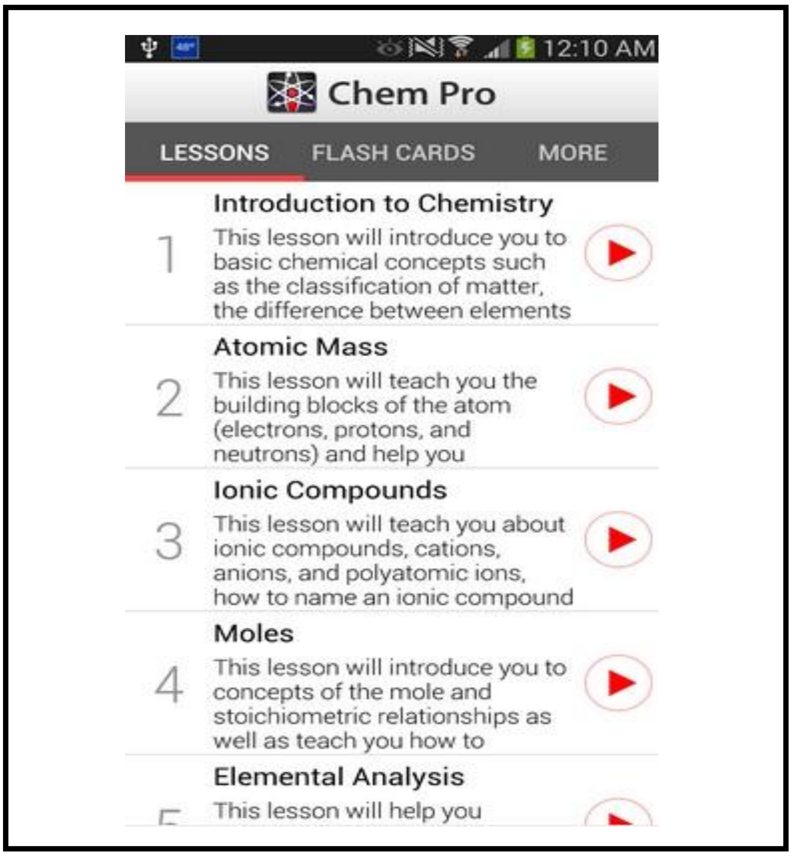

Figure 2.8 : Screen shot of Chem Pro: Chemistry Tutor app (iHelpNYC,2013)

Chem Pro : Chemistry Tutor is mobile app that containing a total of 80 videos which cover the entire course of General Chemistry. This videos can help students after step out from the class room where it will teach students on how to solve problems and the most important skill to be master in order to excel in chemistry. This app is different from the other's because the teaching method in this system is by using video's (iHelpNYC,2013).

Table 2.1: Summary on existing Mobie App's that are designed for Chemical Engineering

Existing Mobile App	Advantages	Disadvantages	Similarities	Differences
Chemical Engineer Dictionary (Ain Dictionary Developers, 2013)	X	Not for Chemical Process Dynamic and Control subject	Chemical equation calculation	Used economics to processes that convert raw materials or chemicals into more useful or valuable form
Chemistry Assistance (Mukker,2013)	X	Not for Chemical Process Dynamic and Control subject	Chemical equation calculation	Functions such as calculate molar masses, No.of Moles, calculate Mass percentage(%)
Graph Lite- function plotter (Cassiopeia,2013)	Can plot graph from the result	Not for Chemical Process Dynamic and Control subject	Chemical equation calculation and can plot graph	Define up to 13 parameters and user can explore the graphs(coordinates, tangent, normal)
Chemical Engineering AppSuite HD app (Vector,2013)	X	Got charges about RM3.13, for iOS and not for Chemical Process Dynamic and Control subject	Chemical equation calculation	Calculation of algebra, electricity, and even in certain areas of physics
Chem Pro: Chemistry Tutor (iHelpNYC,2013)	Different teaching method which is by using video	Student tend to get bored without exploring them self the app and not for Chemical Process Dynamic and Control subject	Chemical equation calculation	Teaching method in this app is by using video's

2.6 User interface based on Human Computer Interaction for Mobile Application

For this project, HCI for mobile application is very important where the application must user friendly to the user's. To ensure this application full the HCI requirements, I have done some researches on internet and I have found out some important criteria or characteristics of user friendly interface. Followings are example criteria or characteristics of user friendly interface:

i. Clean Presentation

It's all about whether the user can read the interface when they are walking? Is it easy to read the fonts? Is it balanced contrast to see the interface in sunlight? Are the buttons big enough to press with fingers? It will be difficult for user to use the mobile application if fail to fulfill any of these categories. (Fenton,2012)

ii. Intuitive User Experience

Based on Fenton (2012) the application has to be easy to understand without a manual to figure it out. It needs to be simply and clearly convey the user.

iii. Attractive Design

The application must be attractive enough in order to attract the user to use this application. It shouldn't be dull and boring where this can make the user bored to use this application.(Fenton,2012)

2.7 Conclusion

There are many Mobile Applications which are designed especially for Chemical Engineering student but however, there are no any application that are designed specifically for Chemical Process Dynamic and Control (CPDC) subject. The research on existing app's are summarised in Table 2.0 below.

CHAPTER 3
METHODOLOGY

3.1 Introduction

In this chapter, the methodology being used is further discussed. There are two main groups of methodologies, which are the system development life cycle (SDLC) methodology and the research methodology. The SDLC methodology that has been chosen is the Rapid Application Development (RAD) methodology followed by a qualitative research methodology for research.

3.2 Research Methodology

The methodology that will be applied for the purpose of this project is Rapid Application Development Process (RAD). This particular software development methodology is widely throughout the world. This software development life cycle methodology comprises s of a short planning stage to concentrate on the prototyping phase. Upon the completion of the requirement gathering phase, which consists of the planning and analysis process, the prototyping phase takes place, followed by the testing and deployment phase. The RAD methodology is illustrated in Figure 3.1 below.

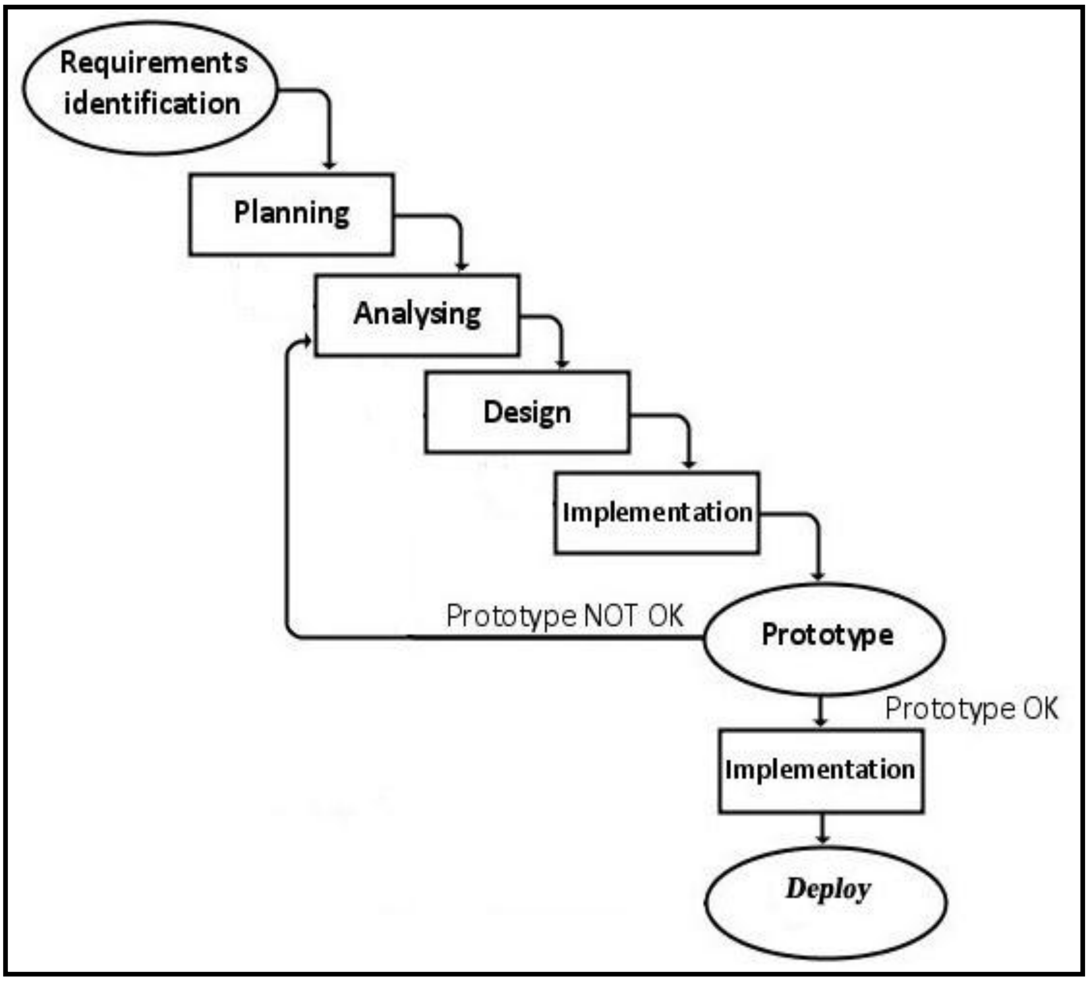

Figure 3.1: Rapid Application Development Methodologies

In RAD model, the development is done concurrently for prototype and are integrated to make the complete product for faster product delivery.Since there is no detailed preplanning, it makes it easier to incorporate the changes within the development process. The activities of the project can be grouped into 3 main phases which is requirement gathering, prototyping , and deployment of the system.

3.2.1 Requirement Identification

The submission of project title with the endorsement of supervisor took place in week 2 of FYP 1. This is followed by a planning of schedule done by producing a Gannt chart and key milestones. The purpose of these deliverables are to ensure time is managed efficiently to complete the project. The key milestone and Gantt chart is shown in Table 3.1 and Table 3.2 respectively below.

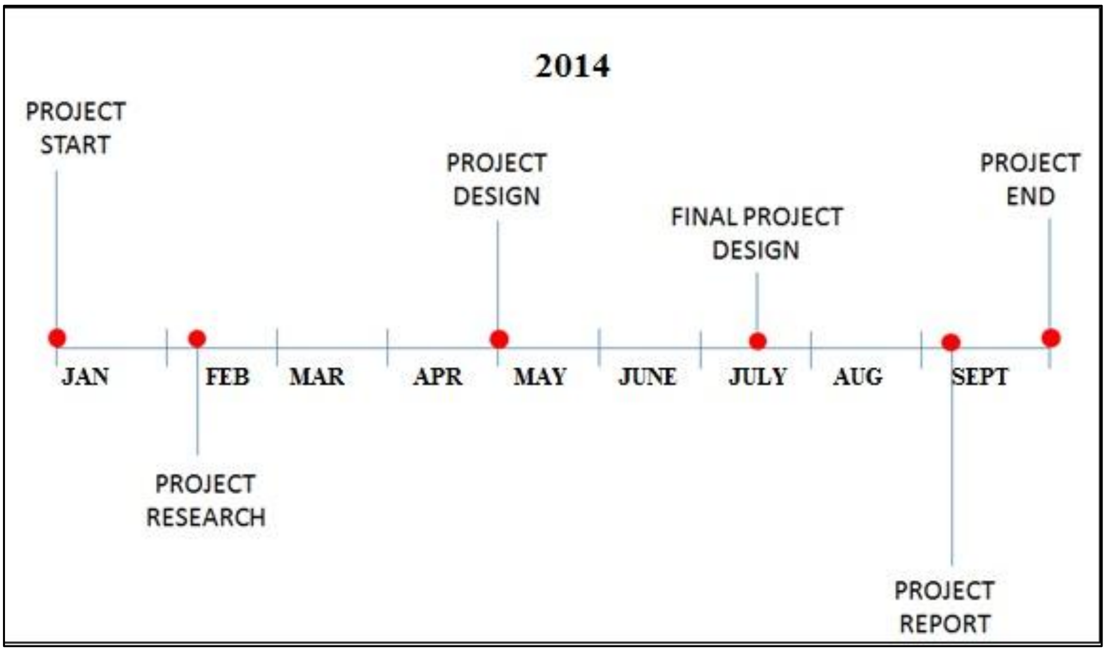

Figure 3.2 : Key Milestone for FYP1 & FYP2

During this phase all the requirements will be identified. Preliminary research was done by visiting an Chemical Engineering lab at UTP. The objective of this visit is to gather information and analyse on the learning method, taking and knowing the current, traditional method of learning CPDC. The method that is used for data collection is through survey and questionnaire.
Analysis is being done by critically analysing the journals and other reliable sources for current existing system. The outcome of the surveys and questionnaires were also classified. This analysis on the literature review is useful to enable comparative study on the current app’s with new one.

Table 3.1: Gantt Chart for FYP1 and FYP2

Project Tasks	**Month**								
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**
Project Title Selection									
Planning and Research Phase • Literature Review									
Design and Simulation Phase • Proposing design, simulation and analyzing									
Optimization of Design Phase • Modification to achieve optimization									
Presentation Phase • Progress Report • Pre SEDEX • Draft Report • Dissertation • Technical Paper • Oral Presentation • Project Dissertation									

3.2.2 Planning

Plan on how to build the application and what platform will be used. Android operating system is been choose for this project as it is the most popular Operating System nowadays and will be using Eclipse as the platform to develop the app. There are plan on the time allocated on each step of this project so that it will be finished before the due date.

In the nutshell, the main objective of this phase is for information gathering and to gain full understanding regarding all components. In this phase, I did some survey and also research conducted by giving questionnaire's to the chemical engineering students who are currently doing their 3rd year 1st semester and 3rd year 2nd semester. This research and survey can give better understanding about the need of student and the problem or difficulties that student facing in Process Dynamic and control subject.

3.2.3 Analysis

A few actions that have been taken in this project were:

- Study and making comparison with available application in the market that has similarity with Android App Suite Chemical Engineering concept.
- Research on how to develop the application. The common and most popular tool to develop an Android application is Eclipse IDE for Java Developers.
- Study about the flow of the application. It is consists of how to operate and manage the application in a right way.
- Discussion with Supervisor and experts. The discussion is very important because the Supervisor and the experts have higher level of knowledge to help me in this project. Examples of experts are my friends who have been working on Android project during their Internship Program.

For this project the Chemical engineering student would be the targeted end users. The targeted users for his project are android-based smart phone user aged between

19 to 30 years and also a chemical engineering student who are currently in 3rd year 1st semester and 3rd year 2nd semester. The reason for this age range is because of the popularity of android smart phone of this range gap and also this mobile app is mainly for chemical engineering student . Furthermore, this age group who known as generation Y would be considered to be technology savvy. Issues that are involved in this context would be the user requirement, user wants and user needs. Hence the author conducted a survey that involved 20 respondents of the mention age range to collect useful information and user requirement that can be used for this project. From the survey, the author has concluded some functionality that would be included in the system. The functions that have been indentified include:

- The application should be able to explain what is process dynamic and control is all about.
- The application should able to calculate the process control.
- The application should show the result and changes in graphical mode.

The analysis part also required to indentify the tools that would be used for the project. The tools identified for the project is divided into hardware and software.

The required hardware includes :

- Computer
- Tablet
- Mobile phone

The software required is:

- Eclipse app inventor

The main and the most important software used for this project development is Eclipse. Eclipse is one of the most popular Android development platform used by the majority of the Android developers around the world. It is open source software, hence a lot of tutorials and source code available on the internet. That is the main advantage of Android development using Eclipse. With java language, Eclipse able to build Android application and also design the layout or interface of the application using xml format.

- Android Development Tools (ADT)

AVD is an emulator that stimulates a real Android device such as smart phone and tablet PC. In other words, AVD can be used as a medium to see how the Android application works on real Android devices without having to buy them on the market.

3.2.4 Design

3.2.4.1 Activity Diagram

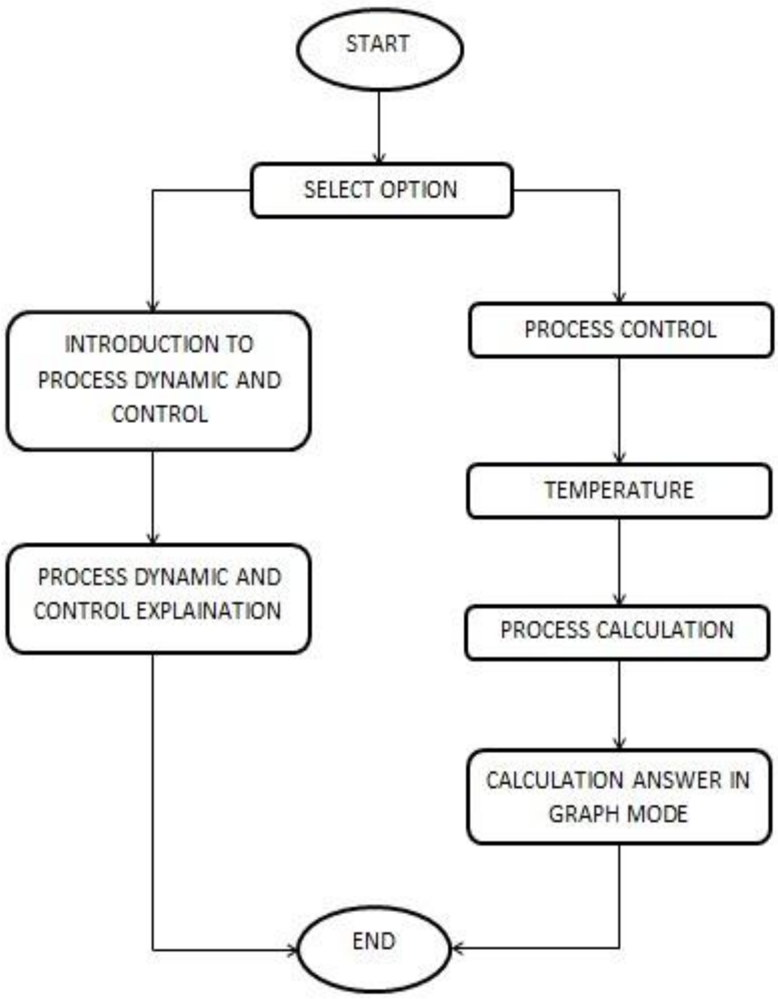

Figure 3.3 : Activity Diagram

The design of the application will be based on the results of the analysis phase. In this phase I have been designed many application design that can be used as my final prototype. The design phase is carried out during the first semester. The design phase will focus on interface design and function design. Interface design is based on user interactivity. The interface will be design to be as user friendly as possible. Function design will be based on the operations that the application will execute. Each function will be design separately and integration of function will be implemented once the design for each function has been completed.

3.2.5 Prototype

The prototype usually used when the user changed the process or the users have some different idea on built the system, then it will take place in this prototype phase. The cycle will be repeat until the system successfully meets the user's requirements. The final prototype will be used and it will be the system or the application.

3.2.6 Implementation

The implementation involves the development of the application. This phase will focus on the coding and programming of the prototype. System testing is done after completion of the coding and programming of the prototype. Implementation begins by completing the design of the home or main page of the system and after that proceed to design other or sub pages of the system. After design the interface of each of the system, the next phase would be to code the functionality of each interface.

3.2.7 Deploy

The output of the project would be a prototype. Hence this eliminates the need for system training. However user acceptance test will be conducted to see if the application is fully functioning. The application then will be deployed to the real environment and can be used by the actual users in the market.

3.3 Brief overview of the system:

Android App Suite Chemical Engineering is an mobile or smartphone application that functions to help chemical engineering student learn Process Dynamic and control subject in alternative way which is by using this application. This application is fully operated by the students to learn the Process Dynamic and Control subject. Firstly, the student need to run this application whenever they want or need it. In this application there are two main categories which is introduction to Process Dynamic and Control and Process calculation in Process Dynamic and Control. In introduction to Process Dynamic and Control, the system will explain what is all about the Process Dynamic and Control. Then on the other hand, student can learn about one process which is temperature in Process calculation in Process Dynamic and Control. There are three ways to calculating the temperature process control which are:

- Proportional Controller (P) :

Often control systems are designed using Proportional Control. In this control method, the control system acts in a way that the control effort is proportional to the error. The control effort is proportional to the error in a proportional control system, and that's what makes it a proportional control system. If it doesn't have that property, it isn't a proportional control systems. For this controller, user have to key in the Proportional gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tp), and Set point(SP).

- Proportional Integral Controller (PI) :

The Proportional-Integral (PI) algorithm computes and transmits a controller output (CO) signal every sample time, T, to the final control element (e.g., valve, variable speed pump). The computed CO from the PI algorithm is influenced by the controller tuning parameters and the controller error, e(t). For this PI controller, user have to key in the Proportional gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tp), Integral Time (*T*i) and Set point (Sp)

PI controllers have two tuning parameters to adjust. While this makes them more challenging to tune than a P-Only controller.

- Proportional-Integral-Derivative Controller (PID) :

PID controllers are sold in large quantities and are often the solution of choice when a controller is needed to close the loop. The reason PID controllers are so popular is that using PID gives the designer a larger number of options and those options mean that there are more possibilities for changing the dynamics of the system in a way that helps the designer. If the designer works it right s/he can get the advantages of several effects. In particular, starting with a proportional controller, and adding integral and derivative terms to the control the designer can take advantage of the following effects. For this PID controller, user have to key in the Proportional gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tp), Integral Time (Ti), Derivative Time (*T*d) and Set point (Sp).

3.3.1 Research element:

In order to successfully develop and deploy this application, research must be done. There are several elements in the research which are:

- Research about the steps to develop the application.
- Research about the programming language used to develop the application and how to implement it.
- Interview and seek for important information from the experts.
- Research on how to develop the user friendly interface of the application.

CHAPTER 4
RESULTS & DISCUSSION

4.1 INTRODUCTION

In FYP I and FYP II, several progresses have been achieved. In this project, more experiments and improvements will be done to those progresses to achieve the objectives successfully. This section describes the achieved progresses, the experiments and the improvements done to them.

4.2 BACKGROUND ON TARGET USER

For this project, the target user will be UTP Chemical Engineering student which are currently in 3rd year 1st semester and 3rd year 2nd semester and also Chemical Engineering lecturer. I choose this target user because the Process Dynamic and Control subject are study and teach by this target users. Mostly the Chemical Engineering student that are in 3rd year 1st semester and 3rd year 2nd semester are from 19-30 age range. The reason for this age range is because of the popularity of android smart phone of this range gap and also this mobile app is mainly for chemical engineering student . Furthermore, this age group who known as generation Y would be considered to be technology savvy. On the other hand, the lecturer's will be 30-50 age range.

4.3 QUALITATIVE RESULTS

I done few researches to gain information and/or to gain a better understanding on this mobile application usage and also on Process Dynamic and Control. Below are the researches that I have conducted :

4.3.1 Survey

This is survey where conducted by me on the lab session that conducted by Mr.Noor Yusmiza Chemical engineering lecturer and also survey lecture session in Universiti Teknologi Petronas which consists of 25 student that are smart phone expertise. The problem was the lack of Automatic computerized Process control where a group student's need to share a computer in lab session in order to understand.

Figure 4.1 : Show the scenario where a group students need to share one computer.

So because of this, it may result or produce poor student quality. Other than that because this problem student will perform poorly when they enter working life where this subject become one of the important or a must for chemical engineering student be master in order to be able to design and operate modern plants in future. Other than that, I also learned by survey on how is the computerized Process Dynamic and Control system is working. This computerized system gave me an idea on creating this application.

4.3.2 Questionaire

This research method conducted in Universiti Teknologi Petronas where I randomly choose 20 students who are currently in 3rd year 1st semester and 3rd year 2nd semester. The questions are as per below with graph :

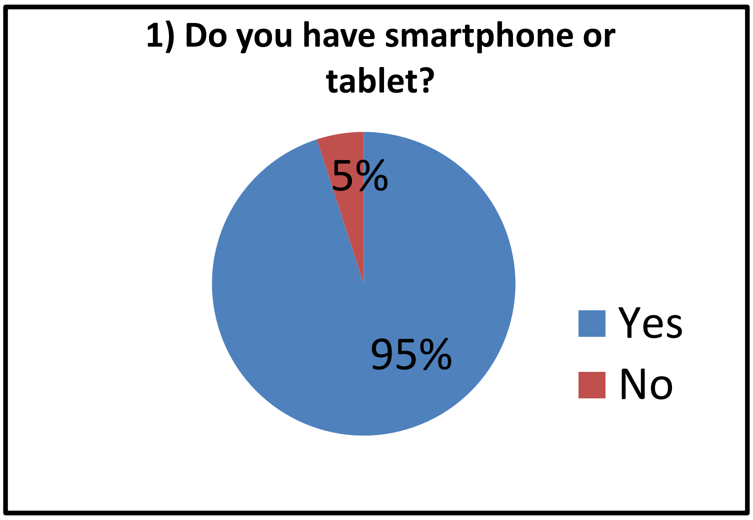

Figure 4.2: Smartphone usage by Chemical Engineering student

Figure above shows the percentage of smart phone usage by Chemical Engineering student. This research are mainly done for Chemical Engineering student. Participant for this research are selected randomly who are from Chemical Engineering Department. From the result of this question, I can see that 19 students out of 20 are using smart phone. This shows that smart phones is a need for students.

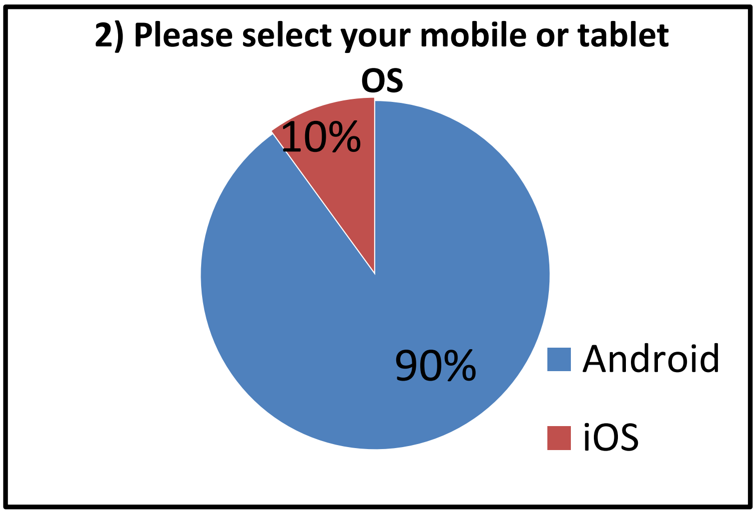

Figure 4.3: Types of Smart phone's operating system

Figure above shows the percentage of smart phone operating system usage by Chemical Engineering student. This research are mainly done to know the type of operating system are preferred by the students.. From the result of this question, I can see that 19 students out of 20 are using Android operating system. This shows that Android operating system is most preferred by sudents.

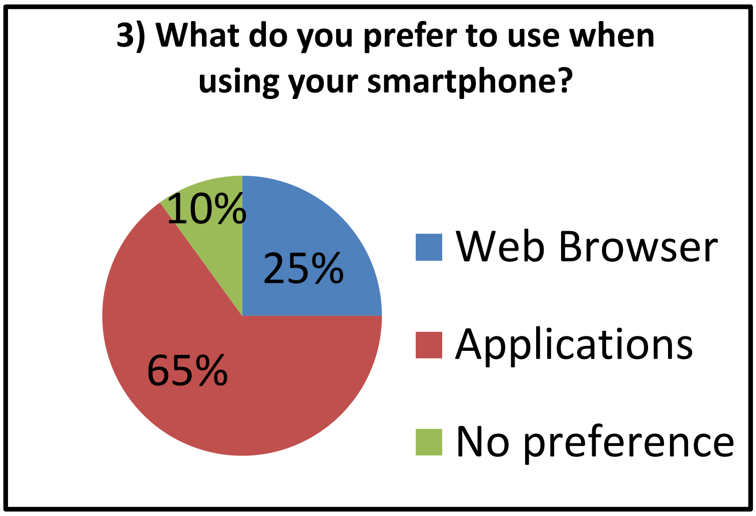

Figure 4.4 : Usage of smart phone

Figure above shows the percentage of smart phone usage purposes. Based on my research I found out that 65% student of 100% prefer to use mobile application. So this proves that developing mobile application can attract the smart phone users.

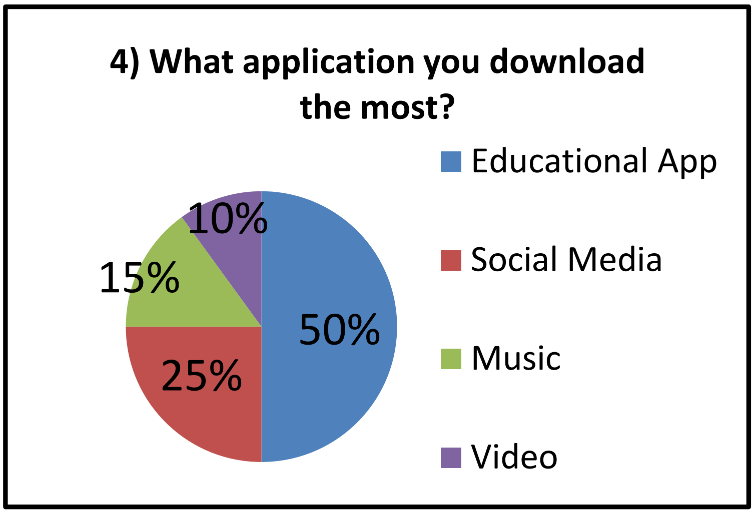

Figure 4.5: Types of application that student prefer.

Figure above shows the percentage of preferable application that is used by student in their smart phones. Based on the my research, I found out that 50% student which means 10 students out of 20 students prefer to use educational application. This also proves that this “Android App Suite Chemical Engineering” which an educational application can attract the chemical engineering student in UTP.

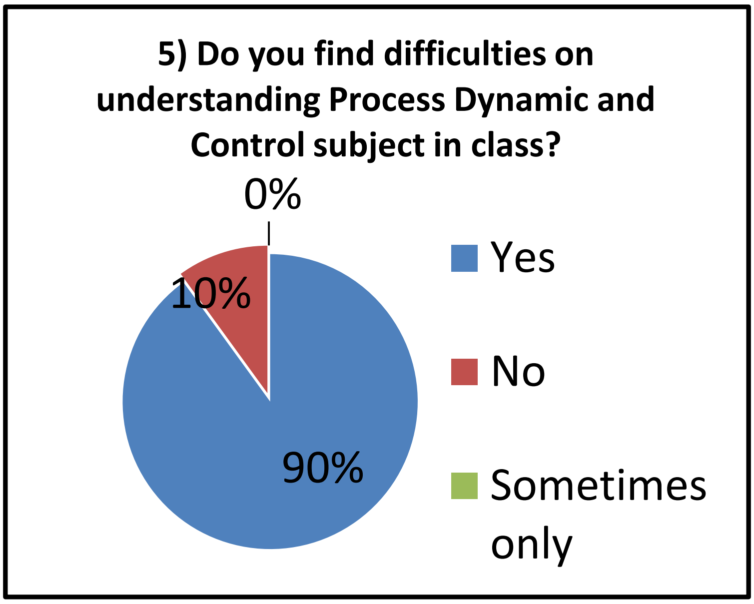

Figure 4.6: Difficulties to understand Process Dynamic and Control Subject.

Figure above shows percentage of student that facing or having difficulties on understanding the Process Dynamic and Control subject. 90 percent which means 18 students out of 20 student facing difficulties on understanding the Process Dynamic and Control subject.

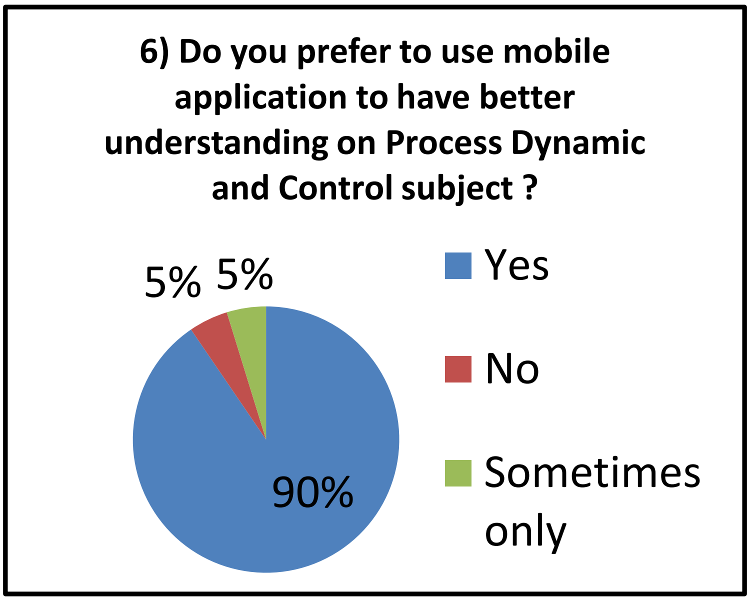

Figure 4.7: Student's view on understanding about Process Dynamic and Control subject by using mobile application.

Figure above shows the percentage of student prefer to learn Process Dynamic and Control in alternate way which is by using mobile application. From my research, I found out that 90% which means 18 students out of 20 students prefer an to learn by using a mobile application.

4.4 Prototype Overview

By following the system flow that has been generated, prototype of the application was developed. The prototyped was built by using the idea of keeping the system configuration as simple as possible so that the chance of having good rating from the users is high. There are several steps where a particular user needs to follow to operate the system.

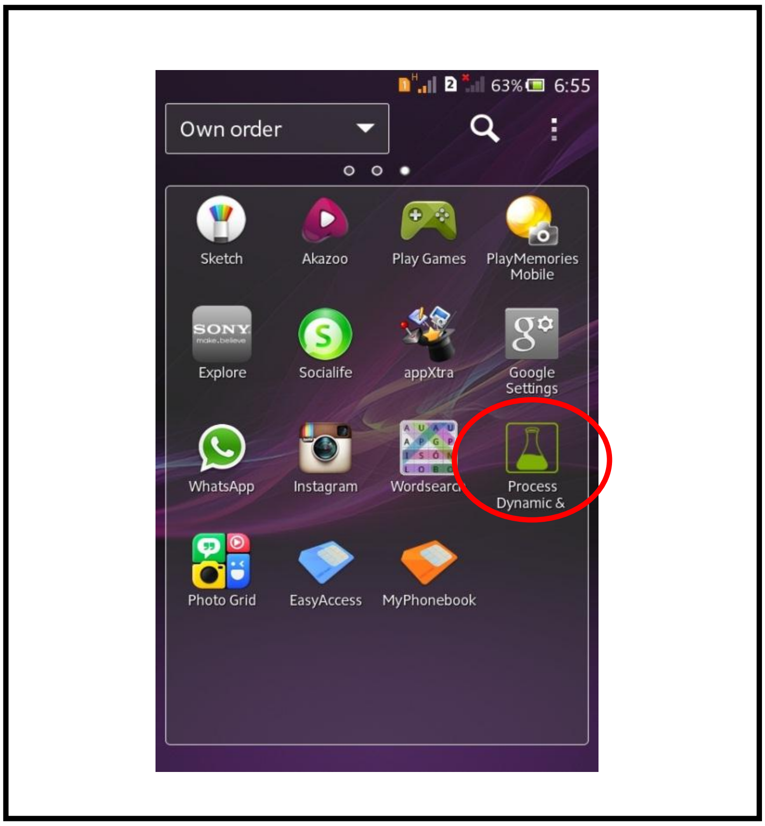

Figure 4.8 : Application's icon on the device

First of all, the users need to click the application's icon on the device's screen. The application's name is Process Dynamic & Control. After the user is successfully logged into the system, they will be navigated to the main page interface.

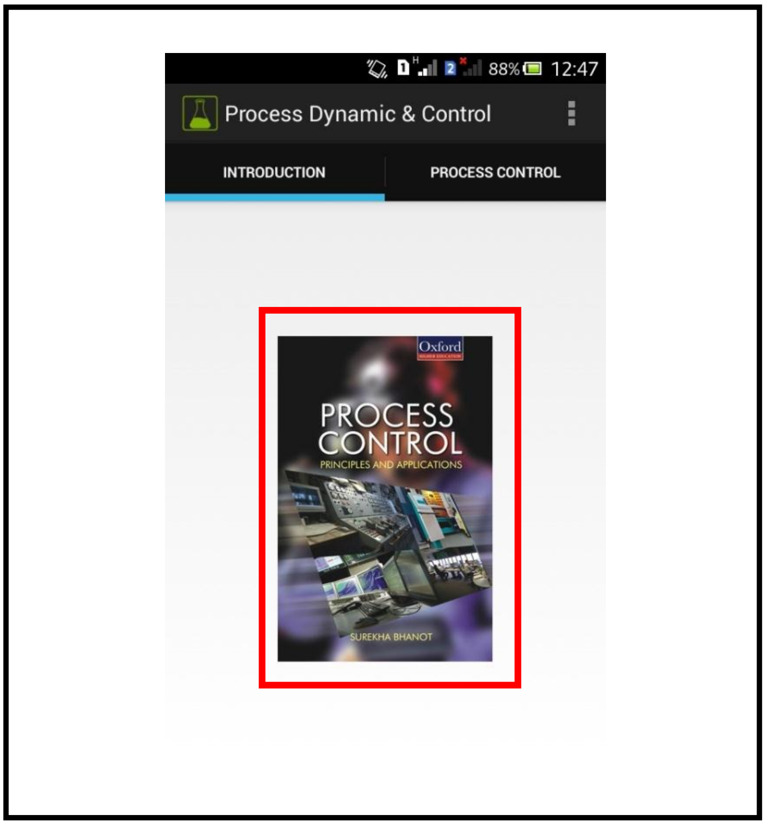

Figure 4.9: Main page interface

The main page of this system are consists of two parts which is introduction part and also process control part. In introduction part, student or user can select the book image in order to read the explanation of Process Dynamic and Control subject. Below is the example of Process Dynamic and Control explanation interface.

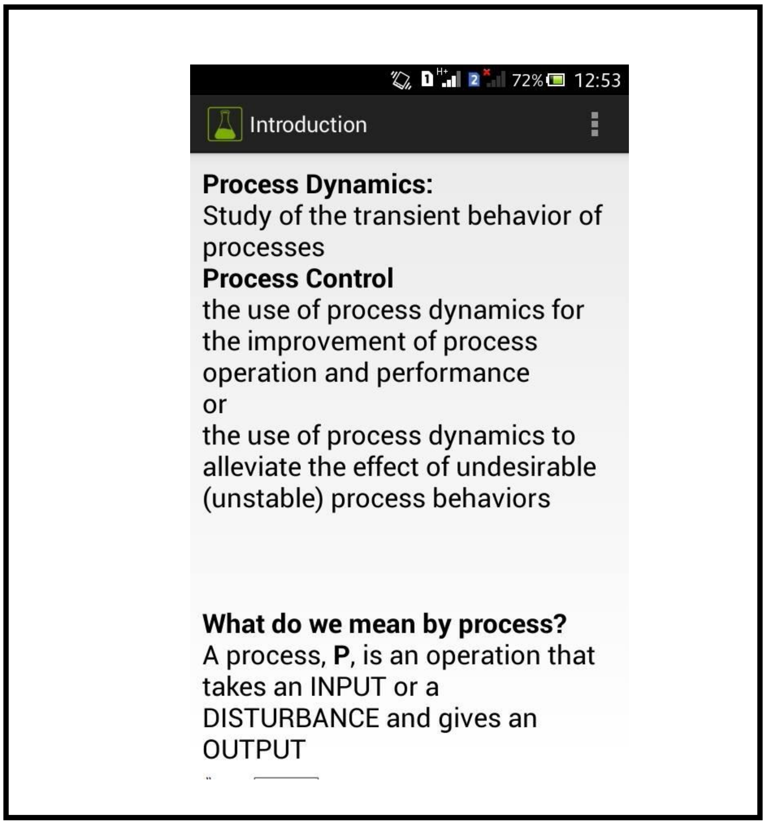

Figure 4.10 : Process Dynamic and Control explanation interface.

After done read the explanation, student or user can proceed to second part which is Process control part by clicking the process control button. If the user want go back to the home page, the student or user can click the home button at the bottom left. Then student or user can proceed to the second part by clicking Process and Control.

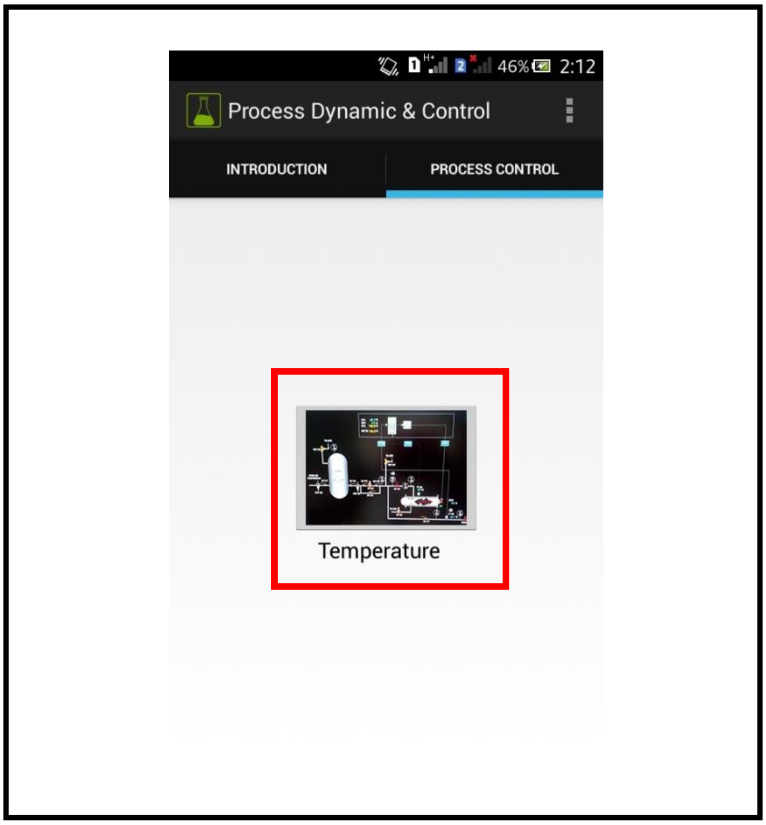

Figure 4.11 : Process and Control main page

Above is the example of Process and Control main page where consists of temperature button with picture. Student or user have to click any of these button in order to learn the temperature control process.

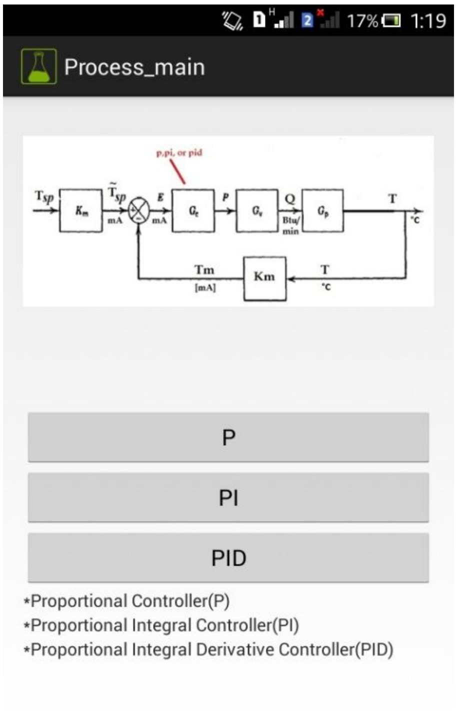

Figure 4.12 : Temperature Process and Control main page

Above is the example of Temperature Process and Control main page where consists of temperature process control module and three button which are P, PI, PID. Student or user have to click any of those button in order to learn the temperature control process in respective way.

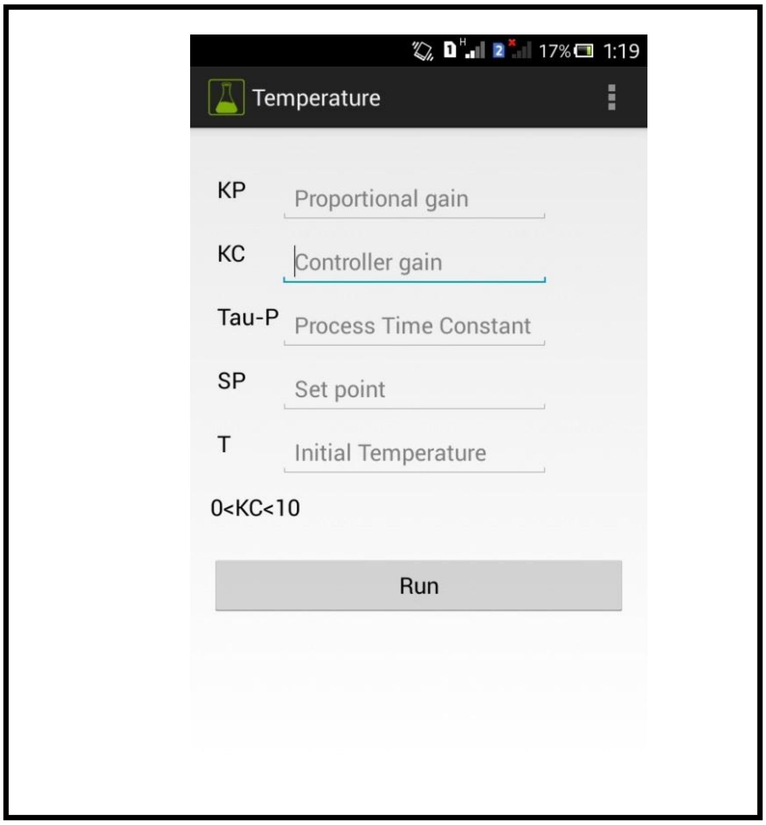

Figure 4.13 : Interface of Proportional Controller User Input

On above interface, there five forms which user have to key in the Process gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tau-p), and Set point(SP). Then once user click Run button, the app will calculate the inputs and will prompt out a graph that represent as the result.

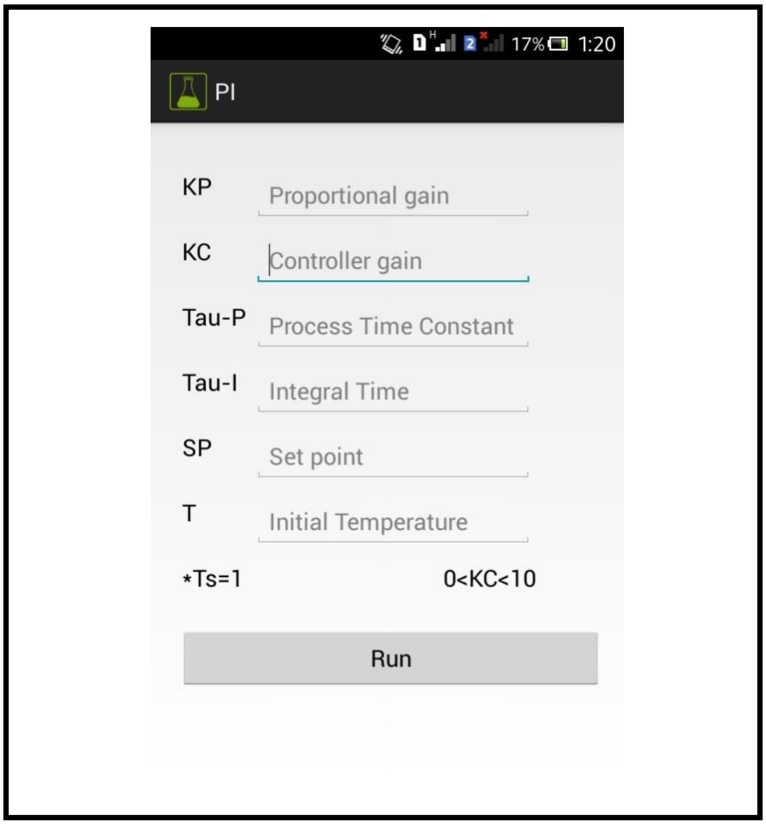

Figure 4.14 : Interface of Proportional Integral Controller User Input

On above interface, there five forms which user have to key in the Process gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tau-p), Integral Time(Tau-I) and Set point(SP). Then once user click Run button, the app will calculate the inputs and will prompt out a graph that represent as the result.

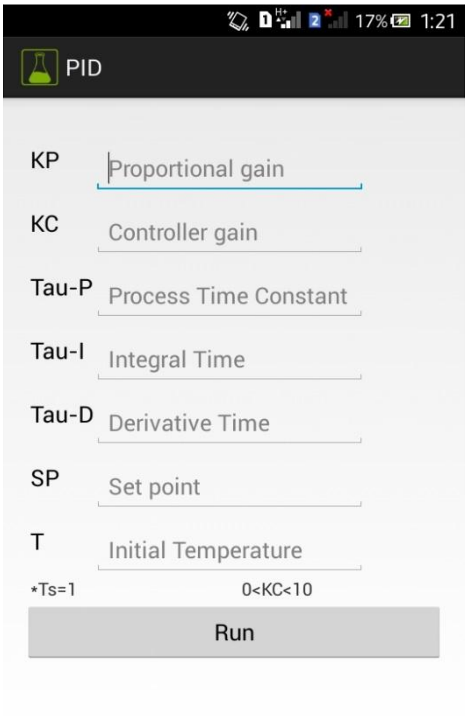

Figure 4.15 : Interface of Proportional Integral Controller User Input

On above interface, there five forms which user have to key in the Process gain(Kp), Controller gain(Kc), Initial Temperature(T), Process Time Constant (Tau-p), Integral Time(Tau-I), Derivative Time(Tau-D) and Set point(SP). Then once user click Run button, the app will calculate the inputs and will prompt out a graph that represent as the result.

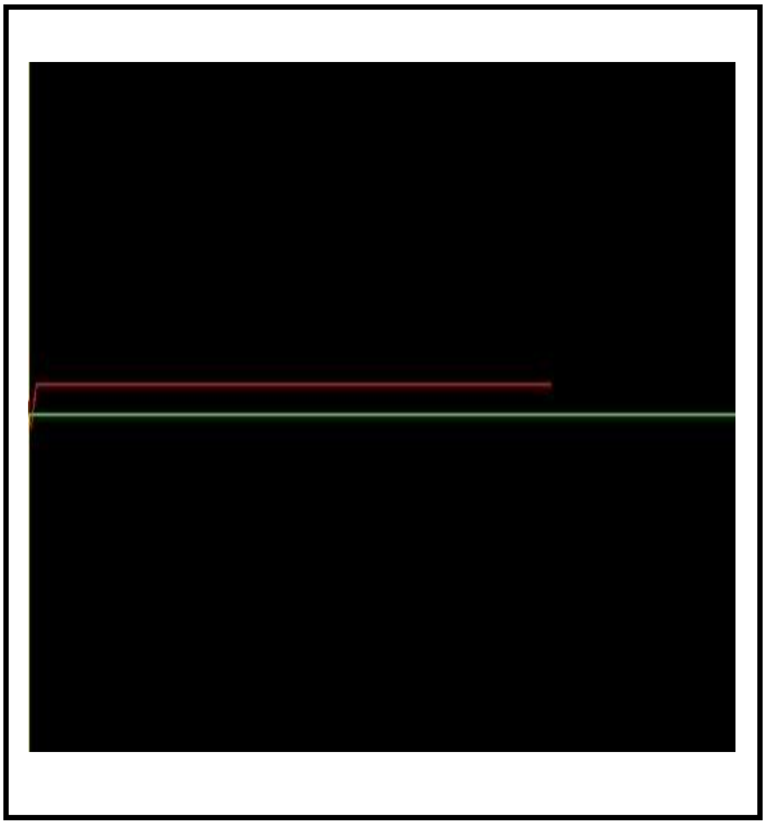

Figure 4.16 : Interface of Proportional Controller result in graph mode

This is an example of graph that are prompt after the user inputs are calculated for proportional controller. This result is for Kp=1 , Kc=0.2, Tau-P=0.3, Sp=10, and T=15.

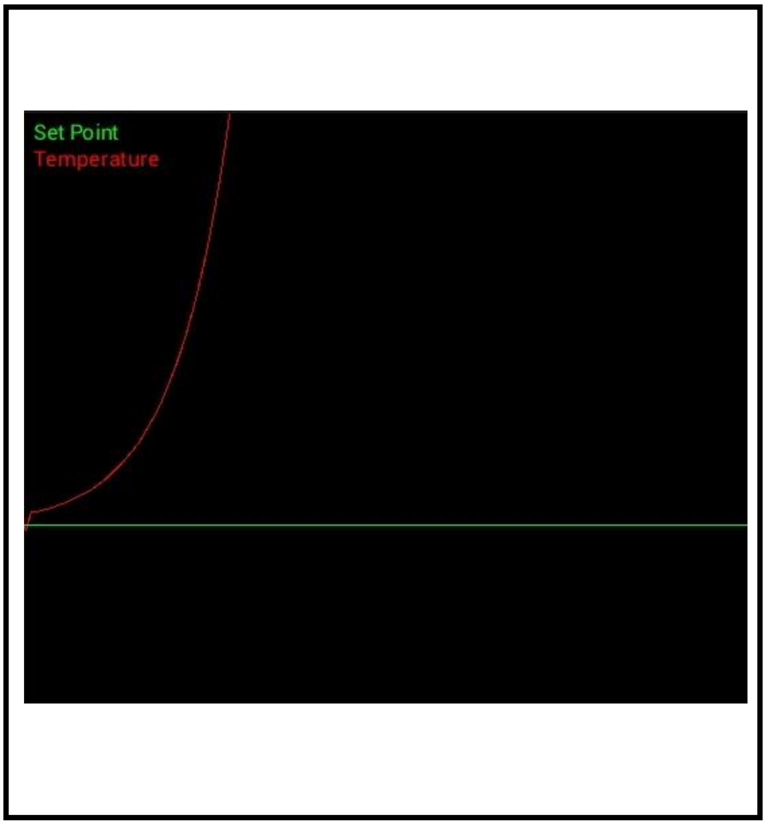

Figure 4.17 : Interface of Proportional Integral Controller result in graph mode

This is an example of graph that are prompt after the user inputs are calculated for proportional controller. This result is for Kp=1 , Kc=0.4, Tau-P=0.5, Tau-I=0.2, Sp=10, and T=15.

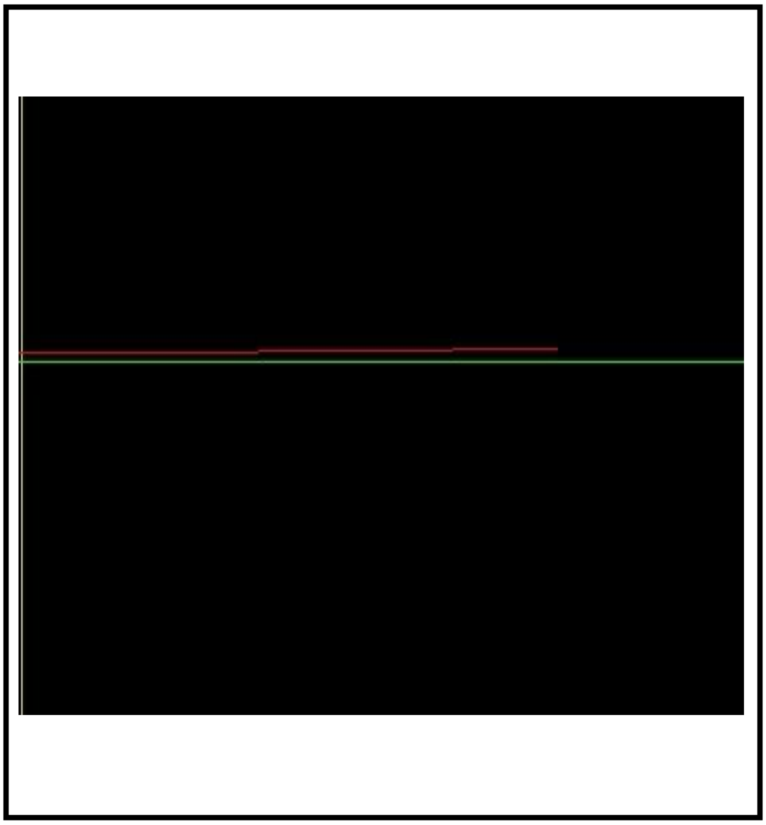

Figure 4.18 : Interface of Proportional Integral Derivative Controller result in graph mode

This is an example of graph that are prompt after the user inputs are calculated for proportional controller. This result is for Kp=0.3 , Kc=0.2, Tau-P=0.6, Tau-I=0.4, Tau-D=0.7, Sp=5, and T=0.

4.5 User Testing and Review

In having more reliable project and ultimate acceptance of the prototype, there are several interviews and testing has been carried out. They are:

1. Survey and feedback(2 Utp Chemical Engineering Lecturer)
2. Acceptance Testing(10 UTP Chemical Engineering student)

4.5.1 Results of Survey and Feedbacks

Part of survey emphasised on the design of the prototype. 100% of respondents are agreed that the design of Android App Suite Chemical Engineering is attractive. In Figure 4.21 , both of them are strongly agreed that the system is attractive as whole.

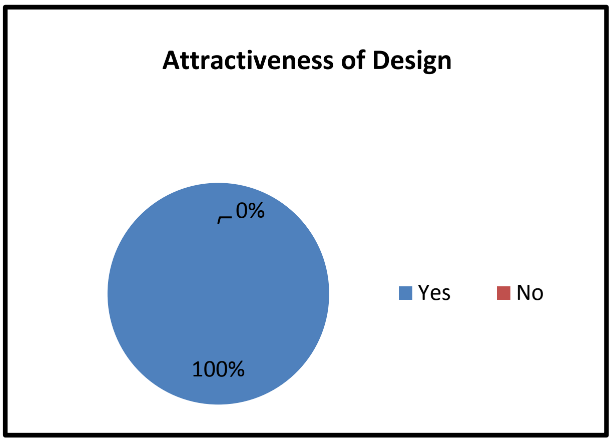

Figure 4.19 : Attractiveness of Prototype

On the other hand, the survey conducted on the functionality of the mobile app. It has been asked whether Android App Suite Chemical Engineering is useful and helpful for student in understanding the Process Dynamic and Control subject. Based on Figure 4.22, both of lecturers are strongly agreed that the system is useful to be implemented in class.

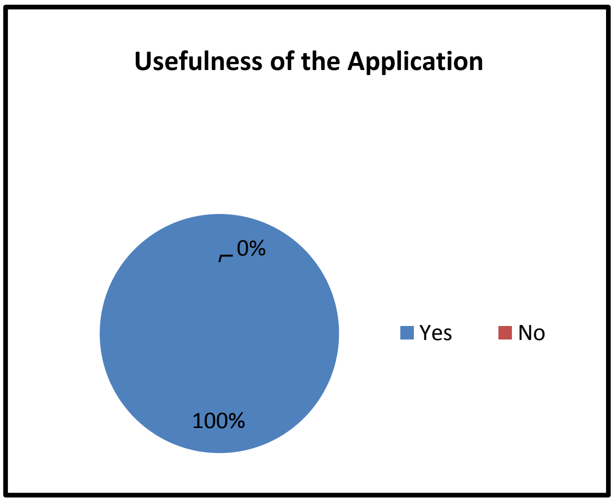

Figure 4.20: Usefulness of the Application

4.5.2 Results of Acceptance Testing

The acceptance testing was done among the 10 Chemical Engineering student of UTP as they are the most suitable candidates to test this system due to subject they taking in UTP which is Process Dynamic and Control. Below are comment that has been given by the student's on the Process Dynamic & Control application.

Table 4.1: Pros and Cons of The Prototype

Pros	Cons
Attractive Design	Lack of other process control
Good App which help student to understand better in the class	
Students can use this application whenever they need.	

Figure 4.21: Student testing on the Android App Suite Chemical Engineering

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

5.1.1 Introduction

"Android App Suite Chemical Engineering" is a mobile application for chemical engineering students in Universiti Teknologi Petronas(UTP) to learn more about chemical Process Dynamic and Control subject at anytime and anywhere. This project would solve the problem that Chemical Engineering students in UTP face in learning Process Dynamic and Control, and them understand about Chemical Process Dynamic and Control (CPDC) subject a) Help students to understand on chemical process dynamic and control subject better.

5.1.2 Project Achievability

The development is done to prove that this mobile app can solve student difficulties which they faced in Process Dynamic and Control subject. This mobile app can give a better understanding to student on Temperature process control by using Proportional Controller (P). Proportional Integral Controller (PI), Proportional Integral Derivative Controller (PID) and see the result in graph mode.

5.1.3 Project Reusability

The proposed research can also be applied to other universities and in process industries. From the survey and feedbacks conducted, it is proved that this project can be applied in bigger scale of work by further enhanced which able to have a good market position if it is commercialized.

5.1.4 Future Work

This project is recommended to further enhanced by implement three other processes such as Flow, Pressure and Level. By implementing this three processes, this app will be complited and can be commercialized.

5.1.5 Summary

This Android project highlights the intelligent system to help student from chemical engineering department easy for them to learn on chemical process dynamic and control.. With continuous implementation, it is believe that the application will be able to achieve the objectives which are:

a)Help students to understand on chemical process dynamic and control subject better .

b)Help students use this application whenever they need, mainly to experience in class while learning about chemical process dynamic and control.

c)Help student Learn easily Process Dynamic and Control calculation and with aid of graph.

For conclusion, the prototype that has been developed is working well according to the APP objectives.

5.2 Recommendations

It is a pride that the application is successfully built and it is working according to what have been planned. However, a lot of improvement in term of interfaces design, features and usability need to be implemented to increase the performance, rating and usability of the application.

First of all, the application needs to have redesign phase where a lot of improvement in term of its icon, images, and interfaces have to be done. To make it easier process, comparisons with other Android applications can be done so that the standard will be at the same level. Other than that, I believe and hope that this application can developed or further enhanced by including all other processes such Flow, Level and Pressure which are in Process Dynamic and Control.

References

Chemical Engineering AppSuite HD. (2013, August 21). Retrieved April 23, 2014, from https://itunes.apple.com/us/app/chemical-engineering-appsuite/id526158171?mt=8

Chen, B., & Denoyelles, A. (2013, October 7). Exploring Students' Mobile Learning Practices in Higher Education (EDUCAUSE Review) | EDUCAUSE.edu. Exploring Students' Mobile Learning Practices in Higher Education (EDUCAUSE Review) | EDUCAUSE.edu. Retrieved March 6, 2014, from http://www.educause.edu/ero/article/exploring-students-mobile-learning-practices-higher-education

Justin, Khor. "Malaysia’s smartphone penetration up 16%." Justin Khor. N.p., 4 Sep 2013. Web. 3 Apr 2014. <http://www.justinkhor.com/malaysias-smartphone-penetration-up-16/>.

Reviews. (2013, September 21). Retrieved March 23, 2014, from https://play.google.com/store/apps/details?id=com.chemicalengineeringapps.chemicalengineeringdictionary&hl=en

Reviews. (2013, October 10). Retrieved March 23, 2014, from https://play.google.com/store/apps/details?id=de.cassiopeia.mathematics.graph.lite&hl=en

Richard, Macmanus. "Morgan Stanley: Mobile Internet Market Will Be Twice The Size of Desktop Internet." readwrite. N.p., 16 december 2009. Web. 3 Apr 2014. <http://readwrite.com/2009/12/15/morgan_stanley_mobile_internet_market>.

S Mukker, A. (2013, August 13). Reviews. Retrieved March 23, 2014, from https://play.google.com/store/apps/details?id=com.aman.periodictable&hl=en

Sharma, Rupali. "Developing for Android - An Introduction." CPorgramming.com. N.p.. Web. 3 Mar2014. <http://www.cprogramming.com/android/android_getting_started.html>.

Should We Allow Cellphones in School? How Students Can Use Smartphones as Learning Tools – Concordia University - Portland Online. (2014, January 1). Concordia University Portland Online. Retrieved March4, 2014, from http://education.cu-portland.edu/blog/tech-ed/should-students-use-their-smartphones-as-learning-tools/

WALKER, FENTON. "Top 5 Rules for Creating User Friendly Mobile Apps." CMS WiRE. N.p., 31 May 2012. Web. 3 Aug 2014. <http://www.cmswire.com/cms/customer-experience/top-5-rules-for-creating-user-friendly-mobile-apps-015841.php>.

. (2013, January 1). . Retrieved August 4, 2014, from http://www.ecyclebest.com/smartphone/articles/smartphones-as-tools-for-education

APPENDICES

Appendix 1 : Source code of the application

Main Page

```
package com.example.chem;
import java.util.ArrayList;
import java.util.List;
import android.annotation.SuppressLint;
import android.app.ActionBar.Tab;
import android.app.ActionBar.TabListener;
import android.app.Activity;
import android.app.ActionBar;
import android.app.Fragment;
import android.app.FragmentTransaction;
import android.app.TabActivity;
import android.content.Intent;
import android.os.Bundle;
import android.view.LayoutInflater;
import android.view.Menu;
import android.view.MenuItem;
import android.view.View;
import android.view.ViewGroup;
import android.widget.Button;
import android.widget.TabHost;
import android.widget.TabHost.TabContentFactory;
import android.widget.TabHost.TabSpec;
import android.widget.Toast;
import android.os.Build;
public class Main extends Activity implements TabListener {
        List<Fragment> fragList = new ArrayList<Fragment>();
        ///////////////CALL INTRODUCTION TEXT
        public void call_introduction_text(View view) {
        Intent intent = new Intent(this, Introduction_text.class);
        startActivity(intent);
  }
        ///////////////CALL INTRODUCTION TEXT
        ///////////////CALL Temperature
        public void call_Temperature(View view) {
                Intent intent = new Intent(this, Process_main.class);
                startActivity(intent);
        }
        ///////////////CALL Temperature
        @Override
        protected void onCreate(Bundle savedInstanceState) {
                super.onCreate(savedInstanceState);
                //setContentView(R.layout.activity_main);
                ActionBar bar = getActionBar();
                bar.setNavigationMode(ActionBar.NAVIGATION_MODE_TABS);
                Tab tab = bar.newTab();
                tab.setText("Introduction");
                tab.setTabListener(this);
                bar.addTab(tab);
                Tab tab2 = bar.newTab();
                tab2.setText("Process Control");
                tab2.setTabListener(this);
                bar.addTab(tab2);
                }
        @Override
        public boolean onCreateOptionsMenu(Menu menu) {
                // Inflate the menu; this adds items to the action bar if it is present.
```

```
		getMenuInflater().inflate(R.menu.main, menu);
		return true;
	}
	@Override
	public void onTabReselected(Tab tab, FragmentTransaction ft) {
	}
	@Override
	public void onTabSelected(Tab tab, FragmentTransaction ft) {
		Fragment f = null;
		TabFragment tf = null;

		if (fragList.size() > tab.getPosition())
				fragList.get(tab.getPosition());
		if (f == null) {
			tf = new TabFragment();
			Bundle data = new Bundle();
			data.putInt("idx",  tab.getPosition());
			tf.setArguments(data);
			fragList.add(tf);
		}
		else
			tf = (TabFragment) f;
		ft.replace(android.R.id.content, tf);
	}
	@Override
	public void onTabUnselected(Tab tab, FragmentTransaction ft) {
		if (fragList.size() > tab.getPosition()) {
			ft.remove(fragList.get(tab.getPosition()));
		}

	}

}
```

Introduction Main Page

```
package com.example.chem;
import android.app.Activity;
import android.app.ActionBar;
import android.app.Fragment;
import android.content.Intent;
import android.os.Bundle;
import android.view.LayoutInflater;
import android.view.Menu;
import android.view.MenuItem;
import android.view.View;
import android.view.ViewGroup;
import android.widget.Button;
import android.widget.Toast;
import android.os.Build;
public class Introduction_main extends Activity {
	@Override
	protected void onCreate(Bundle savedInstanceState) {
		super.onCreate(savedInstanceState);
		setContentView(R.layout.fragment_introduction_main);
		}
	@Override
	public boolean onCreateOptionsMenu(Menu menu) {
		// Inflate the menu; this adds items to the action bar if it is present.
		getMenuInflater().inflate(R.menu.introduction_main, menu);
		return true;
	}
	@Override
	public boolean onOptionsItemSelected(MenuItem item) {
		// Handle action bar item clicks here. The action bar will
		// automatically handle clicks on the Home/Up button, so long
```

```
		// as you specify a parent activity in AndroidManifest.xml.
		int id = item.getItemId();
		if (id == R.id.action_settings) {
			return true;
		}
		return super.onOptionsItemSelected(item);
	}
	/**
	 * A placeholder fragment containing a simple view.
	 */
	public static class PlaceholderFragment extends Fragment {
		public PlaceholderFragment() {
		}
		@Override
		public View onCreateView(LayoutInflater inflater, ViewGroup container,
				Bundle savedInstanceState) {
			View rootView = inflater.inflate(
					R.layout.fragment_introduction_main, container, false);
			return rootView;
		}
	}

}
```

Temperature process control main page

```
package com.example.chem;
import android.app.Activity;
import android.app.ActionBar;
import android.app.Fragment;
import android.content.Intent;
import android.os.Bundle;
import android.view.LayoutInflater;
import android.view.Menu;
import android.view.MenuItem;
import android.view.View;
import android.view.ViewGroup;
import android.widget.Button;
import android.os.Build;
public class Process_main extends Activity {
	@Override
	protected void onCreate(Bundle savedInstanceState) {
		super.onCreate(savedInstanceState);
		setContentView(R.layout.fragment_process_main);
		Button button1= (Button) findViewById(R.id.btn_c_P);
		button1.setOnClickListener(new View.OnClickListener() {
		    @Override
		    public void onClick(View v) {
			call_P();
		    }
		});
		///////
		Button button2= (Button) findViewById(R.id.btn_c_PI);
		button2.setOnClickListener(new View.OnClickListener() {
		    @Override
		    public void onClick(View v) {
			call_PI();
		    }
		});
		///////
		Button button3= (Button) findViewById(R.id.btn_c_PID);
		button3.setOnClickListener(new View.OnClickListener() {
		    @Override
		    public void onClick(View v) {
			call_PID();
		    }
```

```
                });
        }
        ///////////////CALL P
        public void call_P() {
                Intent intent = new Intent(this, P.class);
                startActivity(intent);
        }
        ///////////////CALL P
        ///////////////CALL PI
        public void call_PI() {
                Intent intent = new Intent(this, PI.class);
                startActivity(intent);
        }
        ///////////////CALL PI
        ///////////////CALL PID
        public void call_PID() {
                Intent intent = new Intent(this, PID.class);
                startActivity(intent);
        }
        ///////////////CALL PID
}
```

Graph page

```
package com.example.chem;
import android.content.Context;
import android.graphics.Canvas;
import android.graphics.Color;
import android.graphics.Paint;
import android.view.View;
import android.widget.TextView;
import android.widget.Toast;
public class Drawview extends View {
        int loopz= 100; // the amount of repeat
    Paint green = new Paint();
    Paint red = new Paint();
    Paint yellow = new Paint();
    Paint txt1 = new Paint();
    Paint txt2 = new Paint();
    Paint txt3 = new Paint();
    Paint txt4 = new Paint();
    double SP;
    double[] points = new double[101];
    public Drawview(Context context,double[] pointz,double dSP) {
        super(context);
        green.setColor(Color.GREEN);
        green.setStyle(Paint.Style.STROKE);
        red.setColor(Color.RED);
        red.setStyle(Paint.Style.STROKE);
        yellow.setColor(Color.YELLOW);
        yellow.setStyle(Paint.Style.STROKE);
        points=pointz;
        SP=dSP;
        ///////
    }
    @Override
    public void onDraw(Canvas canvas) {

        float canvasWidth = canvas.getWidth();
        float canvasHeight = canvas.getHeight();
        ////////////////=
        txt1.setColor(Color.GREEN);
        txt1.setTextSize(16);
        canvas.drawText("Set Point", 10, 20, txt1);
        ////////////////
        txt2.setColor(Color.RED);
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        txt2.setTextSize(16);
        canvas.drawText("Temperature", 10, 40, txt2);
        ////////////////
        canvas.drawLine(2, canvasHeight, 2, 0, yellow);
        canvas.drawLine(2, (canvasHeight-2), canvasWidth, (canvasHeight-2), yellow);
        ///
        txt3.setColor(Color.YELLOW);
        txt3.setTextSize(16);
        canvas.drawText("Y:Temperature", 5, (canvasHeight-20), txt3);
        ///
        txt4.setColor(Color.YELLOW);
        txt4.setTextSize(16);
        canvas.drawText("X:Time", 20, (canvasHeight-5), txt4);
        ///////////////
                int last_x=0;
                int last_y=300;
            for (int i = 1; i <= loopz; i++)
            {
                if (i > 0)
                {
                  double thispoint=points[i];
                  int intpointY=((int)thispoint)+300;// +300 for centering screen //
                  int intpointX=i*4;
                    canvas.drawLine(last_x, last_y, intpointX, intpointY, red);
                    last_x = intpointX;
                    last_y = intpointY;
                }
            }
            //
                last_x=0;
                last_y=((int)SP)+300;
            for (int i = 1; i <= 20; i++)
            {
                if (i > 0)
                {
                  //draw SP
                  int intpointY=((int)SP)+300;// +300 for centering screen
                  int intpointX=(int)canvasWidth;
                    canvas.drawLine(last_x, last_y, intpointX, intpointY, green);
                    last_x = intpointX;
                    last_y = intpointY;
                }
            }
    }
}
```